**Observations on the Mating System of Basin Wildrye**

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**Highlight**  
Basin wildrye appears to be an obligate cross pollinator. Under forced self-pollination seed set is less than 2%.

Before an effective plant breeding program can be initiated, certain basic information about the species to be improved is essential. In order to utilize genetic variation effectively and to select desirable genotypes efficiently, some knowledge of the mating system of the species is required. In addition, knowledge of the relative levels of self- and cross-pollination are of value in determining isolation requirements for the production of foundation and certified seed of improved crop varieties, in accordance with the regulations set forth by the Association of Official Seed Certifying Agencies.

Basin wildrye (*Elymus cinereus*) is a relatively unstudied species with significant potential as a native, perennial forage grass in the western United States. Currently, selection programs are in progress at Montana State University to increase yield and palatability in this species. In the summer 1968, levels of self- and cross-pollination were determined by scoring seed set on open pollinated heads, on single bagged heads, and on groups of heads from the same plant under a common bag. As the tip of the head emerged from the boot, it was placed in a glaze bag and the base of the bag was sealed without pinching the culm. The tillers with bagged heads were supported with twine loosely fastened to bamboo poles to allow normal culm elongation and to avoid wind damage to the culm and bag; however, bags were freely agitated by wind throughout the flowering period. Groups of from two to five heads from the same plant were treated in a similar manner. All observations were made on plants grown at Bozeman from a seed collected, Wy 107, obtained through the Soil Conservation Service Plant Materials Center, Bridger, Montana. Studies are currently in progress to determine the chromosome number and meiotic behavior in this population.

At maturity all bagged heads were harvested separately and a random collection of 100 heads from 87 plants was made. Seed set from single bagged heads reflects a minimum level of self-pollination. The difference in seed set with increasing rates of N, and analyzed for total N and nitrate content.

The effect of warm or cool temperatures on percent N was different for warm- and cool-season grasses and varied among individual species. Only two species accumulated nitrate in the cool-temperature regime. Nitrate accumulation under the warm-temperature regime occurred for most of the species, but only after an application of 100 lb N/acre.

Characteristically nitrogen-deficient soils limit rangeland forage production in the western United States. Results from nitrogen fertilization have been varied. Although a lack of increasing forage production after N applications often may be attributed to inadequate rainfall or some other limiting factor, recent studies have indicated that range species react differently to applied N. Thus, knowledge of how each species responds to N fertilization under different environmental conditions would prove valuable in determining the practicability of increasing forage production by N applications. Such knowledge would make it possible to select range species for reseeding that would respond to fertilization, help establish an optimum rate and timing of N application, and avoid some losses from nitrate poisoning.

Wright and Davidson (1964) showed that the response to N fertilization of a given plant species is affected by factors in addition to moisture, including temperature, soil, light intensity, rate of N application, micronutrients, and genetics.
herbicides, and stages of plant growth. Nitrogen applications to a mixed stand of downy brome (Bromus tectorum) and perennial bluebunch wheatgrass (Agropyron spicatum) in Washington increased yields of downy brome much more than those of the wheatgrass, which often decreased (Wilson et al., 1966). In a mixed stand of hardinggrass (Phalaris tuberosa) and soft chess (Bromus mollis) in California, 60 lb N/acre doubled the yields of soft chess, whereas 120 to 240 lb N/acre were required to produce a similar response in hardinggrass (Martin et al., 1964). Soft chess yields were no greater with the very high rates of N than with the lower rate.

The present study was designed to observe the effects of warm and cool temperatures on N concentration of eight grass species, most of which are useful as livestock forage. Two of the species studied were warm-season or summer growing grasses and the other six were cool-season grasses.

Materials and Methods

The two warm-season grasses studied were coastal bermudagrass (Cynodon dactylon) and Entolasia imbricata, an East African species. Cool-season grasses included Malpais bluegrass (Poa scabrella), purple stipo (Stipa pulchra), tall fescue (Festuca arundinacea), Arizona fescue (Festuca arizonica), tall wheatgrass (Agropyron elongatum), and annual ryegrass (Lolium multiflorum).

Six plants of each species, with the exception of annual ryegrass, were cloned to four separate plants and planted in 6-inch clay pots. Annual ryegrass was planted from seed. A standard greenhouse soil mix was used, consisting of a 1:1 combination of fine sand and peat moss plus necessary plant nutrients.

Grasses were grown in the greenhouse for 35 days. Four rates of NH4NO3 (equivalent to 0, 50, 100, and 150 lb N/acre, based on surface area in the pots) were then applied, and the six replicates were divided into two groups. One group was placed in a controlled environment chamber set at 45–55°F. The other group was placed in a similar chamber set at 65–85°F. Daylengths in both chambers was 14 hr of light. Plants were irrigated daily as needed with deionized water.

Three weeks after fertilization, visual observations were made of growth response for each species to the two temperature ranges and four fertilization rates. Leaves were then harvested, oven dried, ground in a Wiley mill equipped with a 40-mesh screen, and dried to a uniform moisture level.

The N concentration of each plant species generally increased in proportion to the increase in applied N, but the species differed in their responses to warm- or cool-temperature regimes (Fig. 1). Differences in N concentration due to temperature were not significant for stipo, tall fescue, and tall wheatgrass, but Malpais bluegrass, Arizona fescue, and annual ryegrass were significantly higher in N when grown under the warm-temperature regime. The total N content of coastal bermudagrass was significantly higher under the cool-temperature regime. The total N content of Malpais bluegrass was consistently higher than any of the other species at all of the fertilizer rates and under both temperature regimes.

The nitrate concentration of each species also varied with temperature. Except for bluegrass and Entolasia, no significant nitrate accumulation occurred before 100 lb N/acre was applied. Bermudagrass and tall wheatgrass did not accumulate significant levels of nitrate in response to increased application of N in either temperature range. Under the cool-temperature regime, only Entolasia and bluegrass accumulated significant levels of nitrate. Since a lack of nitrate accumulation indicates that all nitrate taken up into the leaves has been assimilated, one might conclude that the other six species are adapted for N assimilation at cool temperatures. However, coastal bermudagrass, which did not accumulate nitrate under the cool-temperature regimes, also failed to produce any growth. It appears unlikely that bermudagrass would utilize much nitrate in a state of dormancy; therefore, its lack of nitrate under cool temperatures may result more from root inactivity than efficient assimilation.

Under the warm-temperature regime, all species except coastal bermudagrass and tall wheatgrass accumulated significant levels of nitrate but usually only after 100 lb N/acre was applied. Since nitrate accumulation indicates that more nitrate is available than can be utilized, it would appear that more N was applied than needed. Hylton and Ulrich (1968) and Hylton et al.
(1964) suggested that for maximum growth nitrate-N levels of 500 and 1000 ppm are required in the blades of Idaho fescue and Italian ryegrass, respectively. These values are similar to the nitrate-N concentrations of 0.09 to 0.11% which we found to represent statistically significant accumulations of nitrate in the species studied. Thus, it appears that nitrate accumulation at these levels in a grass indicates that maximum growth is being produced under the existing conditions and that additional N is unnecessary.

Nitrate accumulation was greatest in Malpais bluegrass growing under the warm-temperature regime and in Entolasia growing under the cool-temperature regime, even though both grasses were semidormant under these conditions. Obviously, N applications to Malpais bluegrass during the warm season or to Entolasia during the cool season could be hazardous. Application of N to any of the other species during the cool season at rates up to 150 lb N/acre and during the warm season at rates up to 100 lbs N/acre (150 lb N/acre to tall wheatgrass and coastal bermudagrass) would not be hazardous. Except for coastal bermudagrass, which would be dormant under cool conditions, this additional N would be utilized and increase production as long as there was sufficient moisture for growth.

The most significant result of this study, however, is the indication that the total N and nitrate concentrations of grass species are affected by temperature and that the response to temperature changes among grass species is variable. Furthermore, generalizations as to plant response to N by groups of similar grasses such as warm-season or cool-season species should be avoided in the absence of supporting data. Thus, successful rangeland fertilization or selection of range species for reseeding require an awareness of temperature-nitrogen effects. Only those species which can utilize additional N under anticipated temperatures should be fertilized.

LITERATURE CITED


MANAGEMENT NOTES

Use Seeded Ranges in Your Management

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Highlight

Seeded ranges in conjunction with native range can effectively increase productivity and income from ponderosa pine ranges of Colorado. Average weight of weaned calves was 33 lb higher, and gross income per calf $8.95 larger from combined use of seeded and native range than from native range alone. Cows received better nutrition on seeded ranges, which may increase their lifelong production. Similar benefits can be expected by grazing yearlings. Seeding requires an initial investment of about $8.50 per acre which can be repaid within 3 years as a result of increased grazing capacity. Several grasses are recommended for seeding on the basis of their proven performance to meet specific forage needs.

Seed ranges help a livestock operator balance his yearlong forage supply and maximize profits in his operation.

To take advantage of seeded ranges, though, an operator should be aware of the value and potential uses of various species. For more than 20 years the Rocky Mountain Forest and Range Experiment Station has been conducting research in the ponderosa pine zone of Colorado to determine adaptability, establishment, forage values, proper seasons of use, and general management of ranges seeded to introduced or indigenous grasses. From this work, in which 85 species of grass were tested for adaptability, several were found to be very good. Each had its own unique characteristics to fill certain needs and provide green feed during spring or fall when native ranges are dry.

Three grasses are outstanding for furnishing early spring and late fall grazing: Russian wildrye, crested wheatgrass, and Sherman big bluegrass. Russian wildrye has the desirable characteristic of starting growth early in the spring so that it can be used to good advantage in providing forage early and reducing winter feeding. In comparative tests it consistently had sufficient height growth to be grazed in early or mid-April, 5 to 20 days earlier than crested wheatgrass. Grazing to approximately a 3-inch stubble height was found best; weight gains, although smaller than for crested wheatgrass, averaged about 1.5 lb/day and 50 lb/acre for yearling heifers.

At Manitou Experimental Forest, with typically a moist April followed by lower moisture in late May and early June, Russian wildrye often stops growth and leaves tend to dry and turn yellow as moisture decreases. Crested wheatgrass, on the other hand, usually grows some and remains green with limited precipitation. Because of this difference